

SPECIFICATION

TITLE: METHOD AND APPARATUS FOR ALERTING CIVILIAN MOTORISTS
TO THE APPROACH OF EMERGENCY VEHICLES

Priority of United States Provisional Application Serial
No. 60/422,144, filed October 29, 2002, is hereby claimed.

The invention described herein was made in the performance
of work under a NASA contract and is subject to the provisions
of Public Law 96-517 (U.S.C. 202) in which the Contractor has
elected to retain title.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention is to a method and apparatus for alerting
civilian motorists to the approach of emergency vehicles and
more particularly relates to an in-vehicle indicator aimed at
increasing civilian motorists awareness and response time to
approaching emergency vehicles.

2. Background Information

Numerous in-car distractions and/or technology innovations
have reduced the effectiveness of emergency vehicle sirens.
Specifically, in-car stereo systems and advances in "air-type,
noise-reduction" vehicles have limited motorists awareness of
their outside environment. Even the loudest emergency vehicle
sirens and horns have limited affect. For that reason, there is
a need for in-vehicle alert systems or indicators that warn a

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1 civilian motorist of the approach of emergency vehicles that
2 will warn them of approaching emergency vehicles in the area in
3 addition to the audio alert of sirens.

4 It is therefore one object of the present invention to
5 provide an in-vehicle alert system to alert civilian motorists
6 to approaching emergency vehicles.

7 Yet another object of the present invention is to provide
8 an in-vehicle indicator in the form of a dash-based visual
9 indicator as a complementary feature to an audio warning system.

10 Still another object of the present invention is to provide
11 an in-vehicle dash-based visual indicator for civilian motorists
12 in the form of a small, identifiable indicator in the field of
13 vision of the normal dashboard display.

14 Still another object of the present invention is to provide
15 an in-vehicle indicator that warns civilian motorists of
16 approaching emergency vehicles that during normal, non-
17 preemptive behavior would not be visible.

18 Yet another object of the present invention is to provide
19 an in-vehicle indicator to alert civilian motorists to
20 approaching emergency vehicles that includes an icon that blinks
21 during preemptive behavior and displays the approximate
22 direction from which an emergency vehicle is approaching.

23 BRIEF DESCRIPTION OF THE INVENTION

24 The purpose of the present invention is technology aimed at
25 reducing emergency vehicle traffic-related accidents. The

1 invention is also aimed at increasing civilian motorists
2 awareness and response time to approaching emergency vehicles.

3 There is a current need for a combination of new warning
4 approaches when emergency vehicles are in a particular area. As
5 a result, it has been determined that the current need is a
6 combination of two new warning approaches:

- 7 1. Noise reduction, verbal instructions;
 - 8 a) Reduction of distracting internal vehicle
 - 9 radio noise,
 - 10 b) Audio alerts, preemptive car radios
 - 11 identifying and locating emergency vehicles.
- 12 2. Visual in-car indicator;
 - 13 a) Dash-based indicator,
 - 14 b) Display that provides a visual indication
 - 15 of the location of an emergency vehicle.

16 Under current Intelligent Transportation System (ITS)
17 standards, new car RDS (Radio Data System) compliant radios
18 allow sub-carrier interrupt for traffic reports, news, weather
19 and paging. RDS compliant radios allow proprietary applications
20 to transmit data to a vehicle over FM radio stations. New
21 technology developed for ERDS (Emergency Radio Data System) a
22 subset of RDS will be used specifically for emergency proximity
23 alerts. Using RDS a motorist's radio will detect a new report
24 (e.g., automatic traffic reports at selected intervals) and
25 immediately switch to the corresponding station just as a report

1 is started. Using this same sub-carrier interrupt process, a
2 system has been designed whereby emergency vehicles can
3 eliminate or reduce the volume of all compliant car radios
4 within a short radius around the emergency vehicle. As an
5 emergency vehicle comes within range (i.e., approximately 300
6 feet), a transmitter on the emergency vehicle (e.g., a fire
7 truck) transmits a broadcast interrupt signal on pre-selected
8 audio and data sub-carrier frequencies. Using the same 57 KHz
9 sub-carrier interrupt signal emergency vehicles can
10 eliminate/reduce the volume of all RDS compliant vehicle radios
11 within a short radius around the emergency vehicle.

12 An emergency vehicle will send out burst transmissions on
13 all vehicle radio frequencies, that individually include the
14 sub-carrier RDS signal. These transmissions are short enough
15 and have a large enough duty cycle and period to prevent major
16 interference on peripheral (>300 feet) vehicle radios. They are
17 strong enough to insure nearby (<300 feet) vehicles receive a
18 clear RDS sub-carrier interrupt. This requires a 20ms pulse on
19 each frequency every three to five seconds. The power level is
20 dynamically determined by the emergency vehicle using a scanning
21 receiver (computes each frequency output based on current radio
22 station input levels in the area). A motorist's vehicle radio,
23 upon receiving the correct application code interrupt, can then
24 activate either audio or visual alerts within the vehicle. It
25 is only necessary to interrupt the radio every five to seven

1 seconds since built-in latency timing will insure the system has
2 hysteresis. In other words, if an emergency vehicle interrupted
3 a motorist's radio within the last three seconds, it is safe to
4 say that the emergency vehicle is still in the area and the car
5 should maintain the interrupt for a short while longer.

6 This frequency is set aside for emergency notifications,
7 and will also have direct verbal instructions on the approaching
8 emergency vehicle position and type. For instances, the signal
9 might be: "Caution: Fire truck approaching from behind.
10 Please slow down and pull over." This information is composed
11 in the motorist's vehicle using a local GPS sensor and remote
12 GPS positioning of the emergency vehicle (transmitted via RDS or
13 ERDS). Motorists may have the option to enable or disable this
14 feature on their radio, for example when they are in areas where
15 they are unlikely to encounter any emergency vehicles, however
16 it would be expected that they would enable this feature most of
17 the time as it only serves to increase their safety.

18 In addition to the audio alert, a dash-based visual
19 indicator has also been designed, as a complementary (yet not
20 dependent) feature to the audio warnings. This indicator
21 addresses other potential distractions such as cell phones. The
22 visual and audio warning systems are preferably independent.
23 The systems complement each other, but are not mutually
24 dependent. For example, the in-dash visual indicator will work
25 even if the radio is not on. The flashing indicator will alert

1 a motorist to turn on the radio to receive emergency
2 information.

3 Both the emergency vehicle and the civilian motorist's
4 vehicle will have on-board diagnostic computers (OBDs) as well
5 as a global positioning system transceiver. The global
6 positioning system (GPS) transceivers will be standard
7 transceivers readily available. The emergency vehicle will have
8 a EVI master controller providing an output to a EVI transmitter
9 that transmits EVI sub-carrier frequency (data) to the civilian
10 motorist's radio/receiver. The EVI transmitter will also have a
11 primary frequency for transmitting audio to the motorist's
12 radio/receiver.

13 The civilian motorist's vehicle will also have a global
14 positioning system transceiver providing an output to an on-
15 board computer which in turn provides an output to an EVI slave
16 controller. The slave controller provides data-coded
17 instructions to the motorist's radio/receiver and receives
18 emergency vehicle data. This emergency vehicle data is
19 transmitted to an in-dash indicator that is designed to indicate
20 the approach of an emergency vehicle as well as the direction
21 from which the vehicle is approaching.

22 The on-board emergency vehicle diagnostic computer provides
23 speed, acceleration, and other pertinent vehicle data in digital
24 form. It incorporates the information or data from the global
25 positioning system into the data stream. This data is

1 transmitted by the EVI master controller to the EVI transmitter
2 which transmits a EVI primary frequency for audio and a sub-
3 carrier frequency for data to the civilian motorist's radio
4 receiver.

5 An EVI slave controller receives output from an on-board
6 diagnostic computer in the civilian motorist's vehicle that
7 receives emergency vehicle data via an ITS compliant radio,
8 compares it to the local vehicle, and information from the GPS
9 transceiver and drives the in-dash indicator that is the "data
10 coded instruction" back to the ITS radio.

11 The civilian motorist's radio/receiver produced under
12 current ITS standards allows sub-carrier interrupts for traffic
13 reports, news, and weather as well as other emergency
14 information. The civilian motorist's radio has the capability
15 to be automatically and remotely switched from the normal radio
16 station (tape or disk) operation to an "emergency frequency" by
17 the presence of a sub-carrier from the EVI transmitter on the
18 emergency vehicle. The sub-carrier source is used to carry the
19 digital emergency vehicle data to the civilian motorist's radio
20 receiver and activate audio instructions in addition to volume
21 reduction as well as providing input to control and in-dash
22 indicator. Thus the emergency vehicle primary channel (EVI
23 primary frequency) delivers an audio warning to a motorists such
24 as emergency vehicle approaching. This would alert the civilian
25 motorist to listen for the siren and will also indicate a

1 particularly direction of approach.

2 The EVI transmitter transmits on a pre-selected audio and
3 data sub-carrier frequency. This causes the motorist's
4 radio/receiver to be interrupted and switched to an assigned
5 station. This frequency, set aside for emergency notifications,
6 will have direct instructions on the emergency vehicle position
7 and type. For instance, "Caution: Fire truck approaching from
8 behind. Please slow down and pull over."

9 The above and other objects, advantages, and novel features
10 of the invention will be more fully understood from the
11 following detailed description and the accompanying drawings, in
12 which:

13 BRIEF DESCRIPTION OF THE DRAWINGS

14 Figure 1 is a block diagram illustrating the visual/audio
15 hardware configuration for transmitting alert to a civilian
16 motorist.

17 Figure 2 is a diagram illustrating the configuration of a
18 car relative to an approaching emergency vehicle for receiving
19 position information transmitted from the emergency vehicle.

20 Figure 3 illustrates an in-dash indicator to alert a
21 civilian motorist to an approaching emergency vehicle.

22 DETAILED DESCRIPTION OF THE INVENTION

23 A method and apparatus for indicating and alerting civilian
24 motorists to approaching emergency vehicles is illustrated in
25 the block diagram of Figure 1. The system includes a civilian

1 motorist's radio 10 that is constructed according to current ITS
2 compliant standards. That is, radio 10 is a new design under
3 the standards that allows automatic sub-carrier interrupts for
4 traffic reports, news, weather and emergencies. Thus, radio 10
5 not only receives normal AM and FM broadcasts but also can be
6 automatically and remotely interrupted to receive emergency
7 transmissions.

8 The civilian motorist's radio 10 is connected to a slave
9 controller 12 which in turn receives data and information from
10 on-board diagnostic computer (OBD) 14. Data to on-board
11 computer 14 is provided from a global positioning system
12 transceiver 16.

13 Likewise, emergency vehicles will be equipped with a global
14 positioning system transceiver 18 providing an output to an on-
15 board emergency vehicle computer 20. On-board emergency vehicle
16 computer 20 provides information such as speed, acceleration and
17 other pertinent vehicle data in digital form to EVI master
18 controller 22. The output from the emergency vehicle OBD 20 and
19 EVI master controller is transmitted from EVI transmitter 24 to
20 the civilian motorist's radio and receiver 10. Audio alerts
21 from approaching emergency vehicles are provided from civilian
22 motorist's radio/receiver 10 to speakers 26 as will be described
23 in greater detail hereinafter.

24 In addition to the audio alerts provided through speakers
25 20, a visual in-vehicle indicator 28 is provided which also will

1 be described in greater detail hereinafter.

2 If a system is enabled, which in most cases it will be
3 automatic, a motorist's radio 10 will receive and detect input
4 from an emergency vehicle transmitter 24. This input will come
5 from the on-board diagnostic computer 20 in the emergency
6 vehicle receiving input from global positioning system 18 and
7 providing an output to EVI master controller 22 about position,
8 acceleration and other pertinent vehicle data in digital form.
9 EVI master controller 22 accepts digital data from OBD 20 and
10 generates a data stream from EVI transmitter 24 to provide audio
11 output on an EVI primary frequency and data output on an EVI
12 sub-carrier frequency. The EVI sub-carrier frequency from EVI
13 transmitter 24 immediately switches civilian motorist's radio 10
14 to the corresponding emergency frequency on receipt of an output
15 from the emergency vehicle. The sub-carrier defined by ITS
16 standards provides an output designed to eliminate or reduce the
17 volume of all compliant civilian car radios 10 within a short
18 radius around an emergency vehicle.

19 As an emergency vehicle comes within range, OBD computer 20
20 and EVI master controller 22 provide data to EVI transmitter
21 which is transmitted to civilian motorist's radio 10 to switch
22 output to the emergency frequency. EVI transmitter 24 will then
23 transmit pre-selected audio as well as data on sub-carrier
24 frequencies. The frequency set aside by ITS standards for
25 emergency notifications will direct instructions on emergency

1 vehicle position and type to the civilian motorist's radio 10.
2 For example, information such as "Caution: Fire truck
3 approaching from behind. Please slow down and pull over" or
4 other suitable audio information which will be heard by the
5 motorist over speakers 26.

6 In addition to the audio alert, an in-dash visual indicator
7 28 is activated. Dash-based visual indicator 28 is
8 complimentary (yet not dependent) feature that is in addition to
9 the audio warning system output from speakers 26. That is,
10 dash-based visual indicator will be activated even if radio 10
11 is off and will alert a motorist to turn on his radio. Dash-
12 based visual indicator 28 will be placed in control panel 30 of
13 a motorist's vehicle as illustrated in Figure 2. A typical
14 motorist's dashboard having radio 10 and speakers 26 is
15 illustrated. For purposes of this invention, speakers 26 are
16 illustrated as in the dashboard although they would be placed in
17 any suitable convenient location in a vehicle.

18 Preferably, dash-based visual indicator 28 is placed in a
19 convenient position on control panel 30 where it is easily
20 visible by the driver. In this case, it is illustrated as
21 behind but not blocked by steering wheel 32. Dash-based visual
22 indicator 28 can also address other potential distractions such
23 as cell phones. Although a specific design for the visual
24 indicator dash-based visual indicator 28 is presented, the
25 design content is intended for any type of visual indicator

1 (including future customizable LCD dash-based displays). Also a
2 "heads up display" (HUD) similar to that used in aircraft is
3 feasible.

4 The important feature here is the placement of a small, yet
5 quickly identifiable indicator, within the field of vision of a
6 driver that can be quickly and rapidly identified. Preferably
7 during normal, non-preemptive behavior, dash-based visual
8 indicator 28 is not visible. This feature is much like the
9 indicators on control panel 30 such as "engine or oil lights"
10 that are only illuminated when there is a problem. Additionally
11 there may be different, very bright color lights than the normal
12 lights on a control panel 30 of a vehicle so they instantly
13 alert a driver. EVI slave controller 12 in a motorist's vehicle
14 receives emergency vehicle data from EVI transmitter 24 through
15 radio 10, compares it to local vehicle data received from the
16 motorist's OBD computer 14 and drives dash-board visual
17 indicator 28.

18 Another optional but preferred feature would be to strobe
19 these visual signals so they will quickly be brought to the
20 attention of the driver. In the preferred embodiment, the
21 display would include a central illuminated display having the
22 letters "EV" 36 blinking to indicate the approach of an
23 emergency vehicle. Surrounding this central EV display 36 would
24 be a series of dots 38 that would provide an indication of the
25 approach and direction of an emergency vehicle. Each dot 38 on

1 the dash-based visual indicator 28 indicates a particular
2 direction of approach of an emergency vehicle. Beginning at the
3 12 o'clock or upper position, the first dot 40 would indicate
4 for example an emergency vehicle approaching dead ahead.
5 Looking at the illuminated dots in a clockwise direction, the
6 dots would indicate an emergency vehicle approaching ahead right
7 41, with subsequent dots indicating right 42, rear right 38, and
8 behind 43. Subsequent dots from the behind dot 43 would
9 indicate rear left 44, left 45, and ahead left 46, and back
10 again to 12:00 position 40 which is straight ahead. That is,
11 dash-based visual indicator 28 would have bright, blinking or
12 strobed lights around a central illuminating light having an EV
13 36 that indicate various positions. These lights 40 through 46
14 indicate the various positions from straight ahead at the 12
15 o'clock position to ahead right, right, rear right, rear, rear
16 left, left, and ahead left, respectively. Strobing the dots and
17 38 and 40 through 46 such as with a photo flash type light would
18 be a much better attention getter and would instantly notify the
19 driver of an approaching emergency vehicle.

20 The configuration of a civilian motorist's vehicle relative
21 to an emergency vehicle is illustrated in Figure 3. Position
22 information would be transmitted from emergency vehicle 48 to
23 civilian motorist's vehicle 50. The civilian motorist's radio
24 10 receives a stream of data from EVI transmitter 24 switching
25 radio 10 to receive an audio alert over speakers 26.

1 Simultaneously, dash-based visual indicator 28 would illuminate
2 with a pulsing light showing the letters "EV" 36 to indicate the
3 approach of emergency vehicle. Also, strobe lights 38 and 40
4 through 46 would be appropriately illuminated to indicate the
5 approximate direction of approach of emergency vehicle 48. As
6 stated previously, for example, illumination of strobe light 38
7 indicates an emergency vehicle approaching from the rear and to
8 the right.

9 Thus there has been disclosed a novel and unique in-vehicle
10 warning system to alert drivers of approaching emergency
11 vehicles. This system would provide an audio warning to a
12 driver and simultaneously eliminate or reduce the volume of ITS
13 compliant in-car radios within a short radius around an
14 emergency vehicle. Simultaneously, a dash-based visual
15 indicator would be illuminated indicating the approximate
16 direction and approach of emergency vehicle. Strobed, highly-
17 visible lights in the display would blink or flash alerting the
18 driver of an approaching emergency vehicle. This method and
19 apparatus would overcome the problems of in-car distractions
20 that reduces the effectiveness of sirens.

21 This invention is not to be limited by the embodiment shown
22 in the drawings and described in the description which is given
23 by way of example and not of limitation, but only in accordance
24 with the scope of the appended claims.
25